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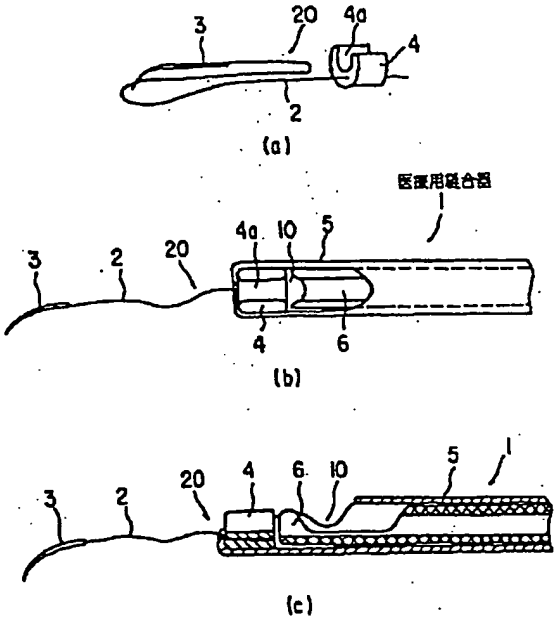
(54)【発明の名称】　医療用縫合器

(57)【要約】
【目的】簡単な縫合作業によって十分な縫合強度を得ることができる医療用縫合器の提供を目的としている。
【構成】本発明の医療用縫合器１は、縫合糸２が接続固定されて成り、前記縫合糸２を収容可能な少なくとも１つの収容部４ａを有する糸止め部材４と、手術部位に挿入可能で且つ前記糸止め部材４を着脱自在にセット可能なシース５と、シース５内に配設され且つシース５内にセットされた糸止め部材４を変形させることによって糸止め部材４の収容部４ａ内に収容された縫合糸２を締め付け固定する糸止め手段６とを具備している。



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【特許請求の範囲】

【請求項１】　縫合糸が接続固定されて成り、前記縫合糸の一部を収容可能な少なくとも１つの収容部を有する糸止め部材と、

手術部位に挿入可能で且つ前記糸止め部材を着脱自在にセット可能なシースと、

前記シース内に配設され、前記シース内にセットされた前記糸止め部材を変形させることによって糸止め部材の前記収容部内に収容された縫合糸を締め付け固定する糸止め手段と、

を具備したことを特徴とする医療用縫合器。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、例えば外科手術で組織を縫合糸によって縫い合わせる際に使用される医療用縫合器に関する。

【０００２】

【従来の技術】従来、生体組織等を縫合糸によって縫い合わせる医療用縫合器としては、例えば米国特許第3,657,056 号に開示されている縫合器がある。この縫合器は、糸の結び目（糸止め）を簡単に作製するために超音波を使用したものであり、糸と糸とを超音波によって接続したり、或いは、ファスナに通した糸の端部を超音波で変形させて頭部状に成形し、これによって、ファスナと糸とを接続するといったものである。

【０００３】また、このような縫合器としては、その他に、米国特許第5,171,251 号、米国特許第5,306,280 号、特開平６－７３６１号公報等に開示されるような縫合クリップがある。この縫合クリップは、２本の足を有するポリマー材料からなるクリップの内部に縫合糸を配置し、この状態で前記クリップに熱を加えてクリップを軟化させた後、クリップに圧縮力を加えてクリップの足を閉じ、その後、熱と圧縮力とを取り除いて、縫合糸とクリップとを裂ぎ止めるといったものである。

【０００４】

【発明が解決しようとする課題】しかしながら、米国特許第3,657,056 号に開示されている超音波縫合器によって縫合糸同志を接続すると、縫合糸同士の接合面積が小さいため、十分な接合強度を得ることができない。また、糸にテンションをかけながら超音波を加えるため、糸がそのテンションと超音波エネルギとによって切れてしまわないように超音波の大きさやその放射時間、糸のテンション等を許容範囲に設定する必要があり、縫合作業や縫合強度が縫合糸それ自身によって制約されてしまう。さらに、縫合糸の端部を頭部状に成形する作業も容易ではない。

【０００５】これに対し、前述した縫合クリップにはこのような欠点がない。しかし、クリップに熱を加えてクリップ全体を軟化させるため、加熱から軟化、冷却、硬化に要する時間が１０秒程度必要となる。このため、迅速な縫合を行なうことができない。また、クリップと糸とを１０秒間保持しておかなければならないため、術者や患者にかなりの負担を強いるとともに、縫合作業の効率が悪い。特に多くの部位をクリップする場合には、その作業が非常に大変である。また、クリップがポリマーであるため、外力によってクリップのヒンジ部が弾性変形を起こし、その結果、クリップの両足が開いて、縫合糸が外れてしまう虞がある。

【０００６】本発明は上記事情に着目してなされたものであり、その目的とするところは、簡単な縫合作業によって十分な縫合強度を得ることができる医療用縫合器を提供することにある。

【０００７】

【課題を解決する手段および作用】上記課題を解決するために、本発明の医療用縫合器は、縫合糸が接続固定されて成り、前記縫合糸の一部を収容可能な少なくとも１つの収容部を有する糸止め部材と、手術部位に挿入可能で且つ前記糸止め部材を着脱自在にセット可能なシースと、前記シース内に配設され且つ前記シース内にセットされた前記糸止め部材を変形させることによって糸止め部材の前記収容部内に収容された縫合糸を締め付け固定する糸止め手段とを具備している。

【０００８】上記構成によれば、糸止め部材の収容部内に縫合糸を引き込んだ状態で糸止め手段により糸止め部材を変形させて縫合糸を締め込み固定することができる。つまり、糸止め手段は、縫合糸が糸止め部材によって締め付けられて糸止め部材に結合されるように、糸止め部材を変形させることができる。特に、前記糸止め手段が、超音波振動エネルギによって前記糸止め部材を変形させる場合には、縫合作業を一層迅速に行なうことができる。

【０００９】

【実施例】以下、図面を参照しつつ本発明の実施例について説明する。図１は本発明の一実施例に係る医療用縫合器１を示している。図１の（ｂ）に示すように、本実施例の縫合器１は、体内に挿入可能な筒状のシース５と、シース５内に進退自在に挿通された中空の超音波プローブ６とから縫合器本体が構成されている。超音波プローブ６は、図示しない超音波振動子と超音波駆動回路とに接続されている。また、シース５の先端部には開口１０が形成され、この開口１０を通じてシース５の先端部内に縫合体２０をセットできるようになっている。

【００１０】すなわち、図１の（ａ）に示すように、前記縫合体２０は、断面がＵ字形状を成す樹脂製の糸止め部材４と、この糸止め部材４に接続固定された縫合糸２と、縫合糸２の先端に設けられた縫合針３とから構成されている。そして、縫合体２０は、糸止め部材４をシース５の開口を通じてシース５の先端部内に嵌め込み固定することによって、シース５に着脱自在にセットされるようになっている。この場合、シース５の開口１０は、

シース５の先端側上面を切り欠いて形成されているとともに、シース５にセットされた糸止め部材４を超音波プローブ６によって前方に押し出した際に糸止め部材４が開口１０の先端側から突出できるようにシース５の先端を大きく切り欠いて形成されているものである。

【００１１】本実施例で使用される縫合糸２は、生体吸収性の樹脂によって形成することが好ましいが、非吸収性のものであっても構わない。また、縫合糸２は、モノフィラメント（単線）とマルチフィラメント（複線）とを使い分けることができる。この場合、モノフィラメントは、引張強度の大きい素材からなるコアと、溶着性の良好な素材からなるクラッドとの２層構造を成すものが好適である。また、マルチフィラメントは、糸を編んで形成したもの、或いは、糸を撚って形成したものが好適である。このようにすることで、糸止め部材４内に縫合糸２を締め込んでこれら両者を結合させる（後述する）際に、糸止め部材４が縫合糸２の編み目や撚り目に食い込んで結合強度が増し、糸止め部材４から縫合糸２が滑り抜けにくくなる。また、この場合、マルチフィラメントは、異なる素材を組み合わせて成るものであっても良い。

【００１２】なお、縫合糸２の先端に設けられる縫合針３は、直線状のものや、湾曲状のもの、或いは、直線状のもので、その先端部が湾曲した形状のものなど、縫合部位によって適宜選択して使用する。

【００１３】次に、上記構成の縫合器１を用いて生体組織の縫合を行なう場合について図２を参照しつつ説明する。まず、シース５に縫合体２０をセットする。この作業は、シース５内の超音波プローブ６を手元側に若干引き込んで、シース５の先端部内に糸止め部材４を収容可能な空間を形成し、この空間内に糸止め部材４を開口１０を通じてセットすることによって行なう。

【００１４】次に、縫合体２０がセットされたシース５を図示しないトラカールを介して体腔内に挿入する。そして、別のルートで体腔内に挿入した持針器（図示せず）で縫合針３を保持しながら縫合すべき生体組織３０に縫合針３を刺し通し、生体組織３０から抜け出た縫合糸２を糸止め部材４のU字溝４ａ内に引き込む（図２の（ａ）の状態）。

【００１５】この状態で、今度は、図２の（ｂ）に示すように、鉗子３２を用いて縫合糸２を引張り、その引張力で組織同志を接合させながら、超音波プローブ６をシース５内で前進させて糸止め部材４に押し付けた状態で、シース５の先端を組織３０の縫合部位に押し付ける。そして、この状態で、超音波プローブ６からの超音波を糸止め部材４に伝達する。これによって、糸止め部材４は、超音波プローブ６からの超音波によってその内部が発熱して軟化するとともに、超音波プローブ６の押圧力によって容易に変形して縫合糸２を締め込む。この時、糸止め部材４の変形とともに縫合糸２を引張りながら超音波プローブ６によって糸止め部材４を組織３０側に押し出してシース５を手元側に引き戻す（図２の（ｃ）の状態）と、糸止め部材４が開口１０（シース５）の先端から抜け出て組織３０の縫合部に圧接するとともに、組織３０に対する縫合強度が増大する。

【００１６】その後、縫合糸２と糸止め部材４とをこの状態で体内に留置する。この時、余分な縫合糸２をハサミ鉗子で切り取って縫合針３とともに回収する。これによって、組織の縫合が完了する。

【００１７】以上説明したように、本実施例の医療用縫合器１によれば、糸止め部材４に形成されたU字溝４ａによって縫合糸２を糸止め部材４内に容易に引き込むことができるとともに、縫合糸２をU字溝４ａ内に引き込んだ状態で、糸止め部材４を超音波によって変形させて縫合糸２を締め込むことができるため、糸止めを確実、容易、且つ迅速に形成することができる。

【００１８】また、超音波によって糸止め部材４を変形させて縫合糸２を締め込み結合させるため、縫合糸２同志を接合して糸止めする場合や、熱によって縫合糸２と糸止め部材４とを圧着する場合に比べて縫合強度が大きい。したがって、その後の外力によって縫合状態が緩まったり、糸止め部材４と縫合糸２との結合状態が解除されてしまうといったことがない。

【００１９】また、超音波プローブ６と糸止め部材４とがシース５内に保持された状態で超音波プローブ６による糸止め部材４の変形を行なうため、縫合作業を容易かつ確実に行なうことができる。

【００２０】また、本実施例の医療用縫合器１では、糸止め部材４を縫合組織３０に押し付けた状態で縫合糸２によって成された組織間接合の接合力を保持させることができるため、つまり、糸止め部材４を縫合組織３０に押し付けた状態で糸止めを行なえるため、糸止め強度が大きく、したがって縫合強度が大きい確実な縫合作業を行なうことができる。

【００２１】図３は糸止め部材４の変形例を示すものである。すなわち、図３の（ａ）に示す糸止め部材４ａはV字形状を有し、図３の（ｂ）に示す糸止め部材４ｂはS字形状を有し、図３の（ｃ）に示す糸止め部材４ｃはW字形状を有し、図３の（ｄ）に示す糸止め部材４ｄはZ字形状を有し、図３の（ｅ）に示す糸止め部材４ｅはX字形状を有し、図３の（ｆ）に示す糸止め部材４ｆはH字形状を有している。いずれの場合も、縫合糸２を容易に引き込むことが可能な溝３５を１つもしくは複数個有している。

【００２２】このような構成によれば、縫合したい組織・手技に応じて、組織を縫った縫合糸２をいずれかの溝３５に引き込むことができる。つまり、縫合糸２を引き込むべき溝３５を選択できる。このように、縫合糸２を都合の良い溝３５に引き込むことができれば、縫合をスムーズに進めることができる。

【００２３】また、図３の（ｇ）に示す糸止め部材４ｇはラッパ形状に形成されている。このような構成では、組織を縫った縫合糸２を縫合針３とともに広い開口部３８から糸止め部材４ｇ内に挿入して狭い開口部３９から引き出す。

【００２４】このラッパ形状の糸止め部材４ｇは、その中に縫合糸２を完全に挿入することができるため、糸止め部材４ｇを変形させて縫合糸２を締め込む際に縫合糸２が糸止め部材４ｇから外れてしまうことがない。したがって、縫合糸２の締め込みが行ない易い。また、広い開口部３８を有するため、糸止め部材４ｇに対して縫合糸２を通し易い。

【００２５】また、図４の（ａ）に示す糸止め部材４０は、縫合糸２を挿通可能な径の異なる複数の穴４０ａ，４０ｂ，４０ｃと、縫った縫合糸２を係止可能な大きさの異なる複数の溝３５ａ，３５ｂ，３５ｃとを有している。つまり、縫合糸２の太さに応じて挿通すべき穴４０ａ，４０ｂ，４０ｃと係止させるべき溝３５ａ，３５ｂ，３５ｃとを選択することができるように形成されている。

【００２６】この構成では、縫合糸２を糸止め部材４０のいずれかの穴４０ａ，４０ｂ，４０ｃ内に挿通した状態で結び目４１を形成して糸止め部材４０に縫合糸２を固定する。そして、この固定状態で、組織を縫った縫合糸２をいずれかの溝３５ａ，３５ｂ，３５ｃに係止させて仮止めを行なう。その後、糸止め部材４０を超音波によって変形させ、糸止め部材４０と縫合糸２とを結合する。

【００２７】すなわち、この構成によれば、溝３５ａ，３５ｂ，３５ｃに縫合糸２を係止させることにより縫合糸２が仮止めされるため、鉗子によって溝３５ａ，３５ｂ，３５ｃ内に縫合糸２を引き込んだ後に鉗子を縫合糸２から離しても、糸止め部材４０を変形させて縫合糸２を締め込む際に、縫合糸２が溝３５ａ，３５ｂ，３５ｃから外れたり、縫合糸２による縫合状態が緩んだりすることがない。

【００２８】図４の（ｂ）に示す糸止め部材４５は、２本の棒４５ａ，４５ｂから成り、これら２本の棒４５ａ，４５ｂはヒンジ４６によって互いに回動自在に連結されている。この構成では、縫合糸２によって組織を縫った後、この縫った縫合糸２を２つの棒４５ａ，４５ｂの間に配置させた状態で棒４５ａ，４５ｂを閉じる。この状態で、超音波により糸止め部材４５を変形させて、縫合糸２を締め付け固定する。

【００２９】図４の（ｃ）に示す糸止め部材５０は、縫合糸２が接続固定される第１の部材５１と、この第１の部材５１に形成された突起５３と係合可能な係合孔５４を有する第２の部材５２とから構成されている。この構成では、縫合糸２によって組織を縫った後、この縫った縫合糸２を２つの部材５１，５２間に配置させた状態で、突起５３を係合孔５４に係合させることによって２つの部材５１，５２を合体させれば、縫合糸２が締め付け固定される。無論、この状態で糸止め部材５０を超音波によって変形させれば、縫合強度が向上する。

【００３０】図４の（ｄ）に示す糸止め部材５５は棒状部材５５ａを備えている。この構成では、縫合糸２によって組織を縫った後、この縫った縫合糸２を棒状部材５５ａに巻き付けた状態で、超音波により縫合糸２と棒状部材５５ａとを溶着させる。

【００３１】図５の（ｂ）に示す糸止め部材６０は、筒状に形成されており、縫合糸２を通すための小径の穴６１を有している。なお、図５の（ａ）は糸止め部材６０を有する縫合体２０を示している。この構成では、縫合糸２を糸止め部材６０の小径の穴６１内に挿通した状態で結び目６３を形成して糸止め部材６０に縫合糸２を固定する。

【００３２】図６は、糸止め部材６０を有する縫合体２０と図１に示した縫合器本体とを用いて生体組織の縫合を行なう様子を示したものである。すなわち、まず初めに、開口１０を通じてシース５の先端部内に糸止め部材６０をセットする。その後、糸止め部材６０がセットされたシース５を図示しないトラカールを介して体腔内に挿入する。そして、持針器（図示せず）で縫合針３を保持しながら縫合すべき生体組織３０に縫合針３を刺し通し、生体組織３０から抜け出た縫合糸２を糸止め部材６０の内孔に引き込む（図６の（ａ）の状態）。

【００３３】この状態で、今度は、鉗子３２を用いて縫合糸２を引張り、その引張力で組織同志を接合させながら、超音波プローブ６をシース５内で前進させて糸止め部材６０に押し付けた状態で、シース５の先端を組織３０の縫合部位に押し付ける。そして、この状態で、超音波プローブ６からの超音波を糸止め部材６０に伝達する。これによって、糸止め部材６０は、超音波プローブ６からの超音波によってその内部が発熱して軟化するとともに、超音波プローブ６の押圧力によって容易に変形して縫合糸２を締め込む。この時、糸止め部材６０の変形とともに縫合糸２を引張りながら超音波プローブ６によって糸止め部材６０を組織３０側に押し出してシース５を手元側に引き戻すと、糸止め部材６０が開口１０（シース５）の先端から抜け出て組織３０の縫合部に圧接するとともに、組織３０に対する縫合強度が増大する（図６の（ｂ）参照）。

【００３４】その後、縫合糸２と糸止め部材６０とをこの状態で体内に留置する。この時、余分な縫合糸２をハサミ鉗子６９（図６の（ｂ）参照）で切り取って縫合針３とともに回収する。これによって、組織の縫合が完了する。

【００３５】その後、別の組織部位を縫合する場合には、ハサミ鉗子６９によって切り取った縫合糸２を別に用意した糸止め部材６０の小径の穴６１に通して（図６

の（ｃ）参照）、再度、結び目６３を形成すれば良い（図6の（ｄ）参照）。

【００３６】このような構成の糸止め部材６０では、これを複数個用意しておくだけで、１本の縫合糸２を複数箇所の縫合に繰り返し使用できるため、経済的である。また、糸止め部材６０は、筒状に形成されており、その中に縫合糸２を完全に挿入することができるため、糸止め部材６０を変形させて縫合糸２を締め込む際に縫合糸２が糸止め部材６０から外れてしまうことがない。

【００３７】図７は糸止め部材６０の変形例を示すものである。図7の（ａ）の糸止め部材６０ａは縫合糸２を挿通可能な径の異なる複数の穴６１ａ，６１ｂ，６１ｃを有している。この構成では、縫合に適した太さの縫合糸２を選択した後、選択した縫合糸２の太さに対応した径の穴６１ａ，６１ｂ，６１ｃに縫合糸２を通す。その後、縫合糸２の末端に結び目６３を作成する。各種の太さの縫合糸２を使用できるため便利である。

【００３８】図7の（ｂ）の糸止め部材６０ｂは口広で先細りの溝７０を有している。この構成では、縫合に適した太さの縫合糸２を選択した後、選択した縫合糸２の太さに対応した深さまで、縫合糸２を溝７０に嵌め込む。縫合糸２の末端に結び目６３を作らなくて良いため縫合作業が楽になる。

【００３９】図7の（ｃ）の糸止め部材６０ｃは幅の異なる複数の溝７３ａ，７３ｂ，７３ｃを有している。この構成では、縫合糸２の太さに応じて嵌め込むべき溝７３ａ，７３ｂ，７３ｃを選択できるので、便利である。

【００４０】図7の（ｄ）の糸止め部材６０ｄは鉤状に突出する突起部７５を有している。この構成では、縫合に適した縫合糸２を選択した後、突起部７５に縫合糸２を結び付ける。

【００４１】図7の（ｅ）の糸止め部材６０ｅには孔７７を有する突出部７６が形成されている。この構成では、縫合に適した縫合糸２を選択した後、孔７７に縫合糸２を結び付ける。

【００４２】なお、以上説明してきた実施例では、糸止め部材を変形させて縫合糸を締め込むことによって縫合糸と糸止め部材との結合を行なっているが、接着、溶着、圧着等によって両者を結合させることができることは言うまでもない、また、上記実施例では、超音波によって糸止め部材を変形させているが、レーザ、ヒータ、電磁波、電気、振動、化学反応等によっても糸止め部材を変形させることができることは言うまでもない。

【００４３】なお、以上説明してきた態様により、以下の項で示す各種の構成が得られる。

１．縫合糸が接続固定されて成り、前記縫合糸の一部を収容可能な少なくとも１つの収容部を有する糸止め部材と、手術部位に挿入可能で且つ前記糸止め部材を着脱自在にセット可能なシースと、前記シース内に配設され且つ前記シース内にセットされた前記糸止め部材を変形させることによって糸止め部材の前記収容部内に収容された縫合糸を締め付け固定する糸止め手段とを具備したことを特徴とする医療用縫合器。

【００４４】２．前記糸止め手段は、超音波振動エネルギによって前記糸止め部材を変形させることを特徴とする第１項に記載の医療用縫合器。この第２項の構成によれば、縫合糸と糸止め部材との固定を迅速に行うことができる。この場合、超音波振動エネルギーは、糸止め部材の内部を発熱させるとともに、糸止め部材同志の接触面を溶着させる作用を有している。

【００４５】３．前記縫合糸が前記糸止め部材に着脱自在に接続固定されていることを特徴とする第１項に記載の医療用縫合器。この第３項の構成によれば、縫合糸を術中に繰り返し使用することができる。

４．前記糸止め部材の前記収容部は縫合糸を係止可能であることを特徴とする第１項に記載の医療用縫合器。

【００４６】

【発明の効果】以上説明したように、本発明の医療用縫合器によれば、簡単な縫合作業によって十分な縫合強度を得ることができる。すなわち、本発明の医療用縫合器は、糸止め部材に形成された収容部によって縫合糸を糸止め部材内に容易に引き込むことができるとともに、縫合糸を収容部内に引き込んだ状態で、糸止め部材を変形させて縫合糸を締め込むことができるため、糸止めを確実、容易、且つ迅速に形成することができる。

【００４７】また、糸止め部材を変形させて縫合糸を締め込み結合させるため、縫合糸同志を接合して糸止めする場合や、熱によって縫合糸と糸止め部材とを圧着する場合に比べて縫合強度が大きい。したがって、その後の外力によって縫合状態が緩まったり、糸止め部材と縫合糸との結合状態が解除されてしまうといったことがない。

【００４８】また、糸止め手段と糸止め部材とをシース内に保持した状態で糸止め手段による糸止め部材の変形を行なわしめることができるため、縫合作業を容易かつ確実に行なうことができる。

【図面の簡単な説明】

【図１】（ａ）は本発明の一実施例に係る医療用縫合器を構成する縫合体の構成図、（ｂ）は医療用縫合器の要部を示す平面図、（ｃ）は医療用縫合器の要部を示す側断面図である。

【図２】図１の医療用縫合器を用いて縫合作業を行なう様子を示す図である。

【図３】縫合体を構成する糸止め部材の変形例を示す図である。

【図４】縫合体を構成する糸止め部材の変形例を示す図である。

【図５】縫合体を構成する糸止め部材の変形例を示す図である。

【図６】図５の縫合体を用いて縫合作業を行なう様子を

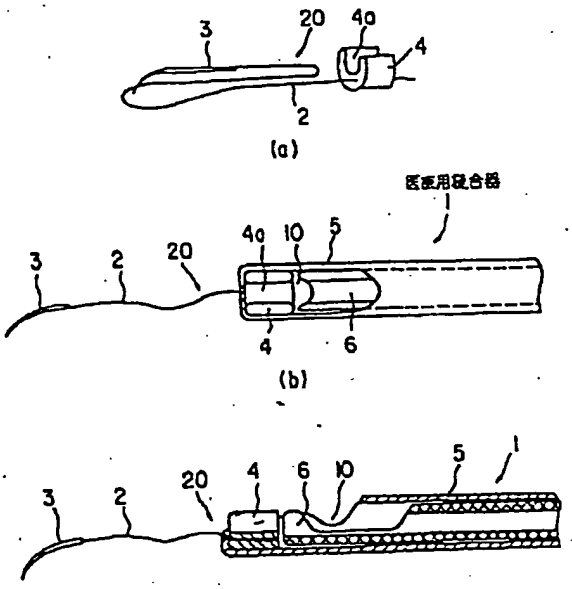
示す図である。

【図7】図5の糸止め部材の変形例を示す図である。

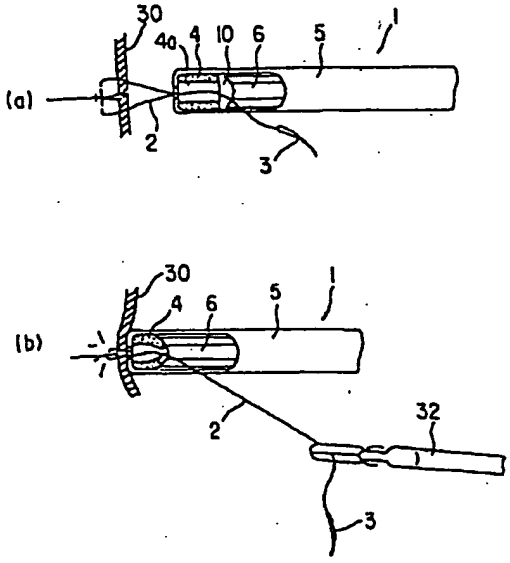
【符号の説明】

1…医療用縫合器、2…縫合糸、3…縫合針、4…糸止め部材、4a…収容溝（収容部）、5…シース、6…超音波プローブ（糸止め手段）。

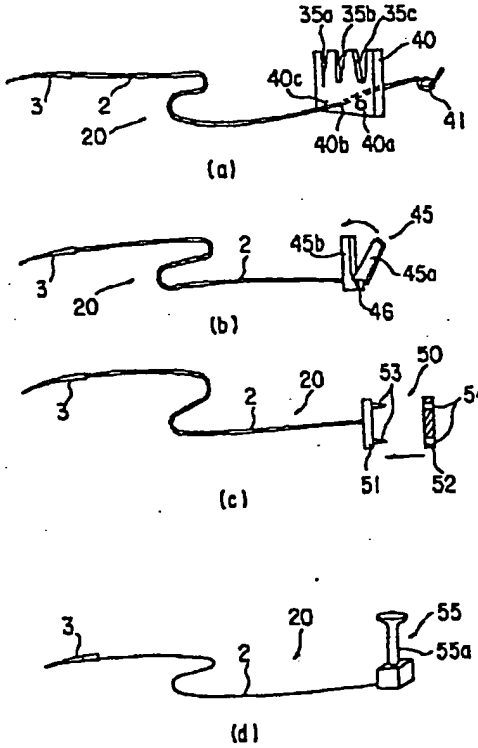
【図1】



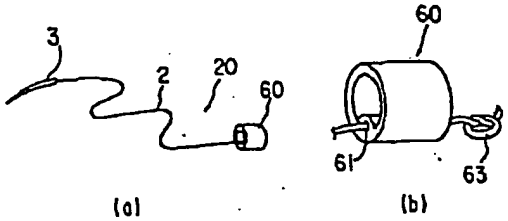
【図2】



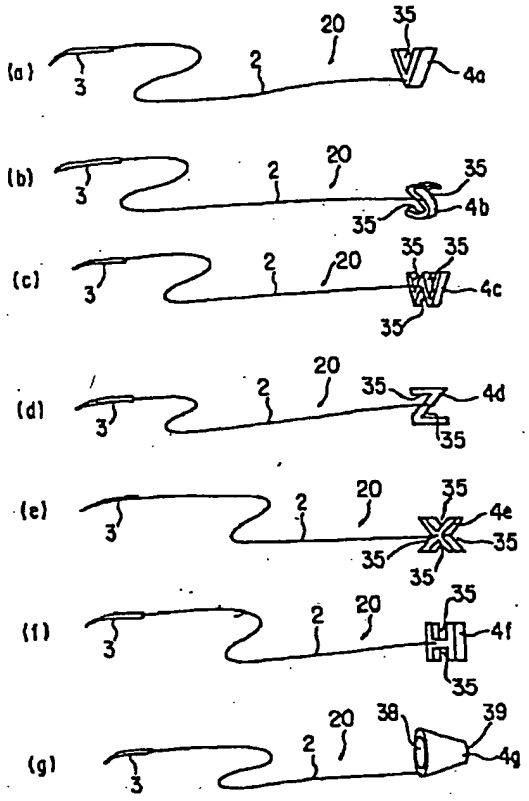
【図4】



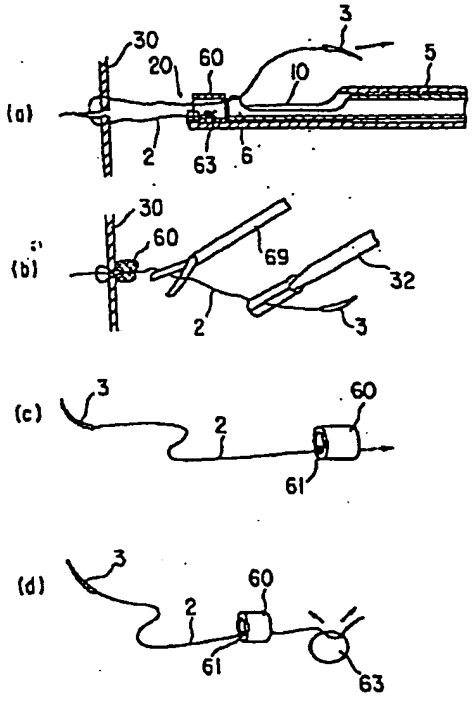
【図5】



【図3】


(a)
(b)
(c)
(d)
(e)
(f)
(g)
2
3
20
35
4a
4b
4c
4d
4e
4f
4g
38
39

【図6】


(a)
(b)
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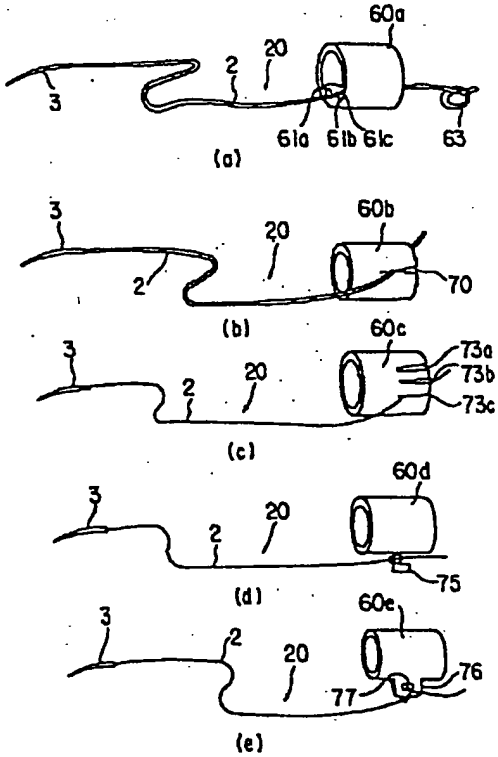
【図7】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73a
73b
73c
75
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(54) [Title of the Invention] MEDICAL SUTURING INSTRUMENT

(57) [Abstract]

[Object] The object of the present invention is to provide a medical suturing instrument which makes it possible to obtain a sufficient suturing strength by a simple suturing operation.

[Structure] A medical suturing instrument 1 in accordance with the present invention comprises a suture locking member 4 having a suture 2 connected and secured thereto and having at least one receiving portion 4a capable of receiving the suture 2, a sheath 5 capable of being inserted into a surgical region and capable of setting the suture locking member 4 so that it can be freely detached therefrom, and suture locking means 6 which is arranged inside the sheath 5 and which fastens and fixes the suture 2 contained inside the receiving portion 4a of the suture locking member 4 by causing the deformation of the suture locking member 4 set into the sheath 5.

[Patent Claims]

[Claim 1] A medical suturing instrument comprising

a suture locking member having a suture connected and secured thereto and having at least one receiving portion capable of receiving a portion of said suture,

a sheath capable of being inserted into a surgical region and capable of setting said suture locking member so that it can be freely detached therefrom, and

suture locking means which is arranged inside said sheath and which fastens and fixes the suture contained inside said receiving portion of the suture locking member by causing the deformation of said suture locking member set into said sheath.

[Detailed Description of the Invention]

[0001]

[Industrial Field of the Invention] The present invention relates to a medical suturing instrument employed for suturing a tissue with a suture in surgical operations.

[0002]

[Description of Prior Art] A suturing instrument disclosed in US Patent 3,657,056 is an example of a medical suturing instrument employed for suturing a body tissue or the like with a suture. In this suturing instrument, ultrasonic waves are used to form easily the thread knots (thread locking), threads are connected to each other with ultrasonic waves, or front ends of threads passed through a fastener are deformed with ultrasonic waves to form a head portion which is used to connect the fastener to the thread.

[0003] Furthermore, other examples of such suturing instruments include suturing clips disclosed in US Patents 5,171,251 and 5,306,280 and Laid-open Japanese Patent Application Heisei 6-7361. In these suturing clips, a suture is placed into a clip consisting of a polymer material and having two legs. In this state, the clip is softened by heating and then a compressive force is applied to the clip to close its legs. Then, the heating and application of compressive force are terminated and the suture and clip are tightly locked.

[0004]

[Problems Addressed by the Invention] However, when the suturing threads are connected to each other with the ultrasonic suturing instrument disclosed in US Patent 3,657,056, since the joining surface area of the two sutures is small, a significant joining strength cannot be obtained. Furthermore, since ultrasonic waves are applied to the suture under tension, the amplitude of ultrasonic waves or irradiation time and tension applied to the suture have to be set within the allowed ranges to prevent the suture rupture by the tension and ultrasonic energy, and the suture itself places limitations on the suturing operation and suturing strength. Furthermore, the formation of a head portion at the front end of a suture is not an easy operation.

[0005] By contrast, the above-described suturing clip is free from these drawbacks. However since the clip body is softened by heating, the time required for softening, cooling, and hardening is within about 10 s. For this reason, fast suturing cannot be conducted. Furthermore, since the clip and suture have to be held for 10 s, a significant burden is placed on the doctor and patient

and the efficiency of suturing operation is poor. In particular, when clipping is conducted in a large number of places, the operation becomes especially difficult. Furthermore, since the clip is made of a polymer, the hinge portion of the clip undergoes elastic deformation under an external force. As a result, the clip legs can be opened and the suturing thread can be released.

[0006] The present invention was developed to overcome the above-described problems and its object is to provide a medical suturing instrument which makes it possible to obtain a sufficient suturing strength by a simple suturing operation.

[0007]

[Means to Resolve the Problems and Operation] In order to resolve the above-described problems, the medical suturing instrument in accordance with the present invention comprises a suture locking member having a suture connected and secured thereto and having at least one receiving portion capable of receiving a portion of the suture, a sheath capable of being inserted into a surgical region and capable of setting the suture locking member so that it can be freely detached therefrom, and suture locking means which is arranged inside the sheath and which fastens and fixes the suture contained inside the receiving portion of the suture locking member by causing the deformation of the suture locking member set into the sheath.

[0008] With the above-described structure, the suture can be fastened and fixed by causing the deformation of the suture locking member with the suture locking means in a state in which the suture is pulled into the receiving portion of the suture locking member. In other words, the suture locking means can cause the deformation of the suture locking member so that the suture is fastened by the suture locking member and joined to the suture locking member. In particular, the suturing operation can be conducted even faster when the suture locking means causes the deformation of the suture locking member with energy of ultrasonic vibrations.

[0009]

[Embodiment] Embodiments of the present invention will be described below with reference to the drawings attached. Fig 1 shows a medical suturing instrument 1 relating to an embodiment of the present invention. As shown in Fig 1(b), in the suturing instrument 1 of this embodiment, the suturing instrument body consists of a cylindrical sheath 5 that can be inserted in the body and a hollow ultrasound probe 6 inserted into the sheath 5 so that it is free to reciprocate therein. The ultrasound probe 6 is connected to an ultrasound oscillator and an ultrasound driving circuit which are not shown in the figure. Furthermore, an orifice 10 is formed in the front end portion of the sheath 5, and a suturing body 20 can be set inside the front end portion of the sheath 5.

[0010] Thus, as shown in Fig 1(a), the suturing body 20 consists of a suture locking member 4 made of a resin and having an U-shaped cross section, a suture 2 connected and secured to the suture locking member 4, and a suturing needle 3 attached to the front end of the suture 2. The suture locking member 4 is passed through the orifice in sheath 5 and fit into and secured to the front end portion of the sheath 5, thereby setting the suturing body 20 onto the sheath 5 so that it can be freely detached therefrom. In this case, the orifice 10 of sheath 5 is formed by cutting the upper surface at the front end of sheath 5 and cutting out a large portion of the front end of

sheath 5 so that when the suture locking member 4 set into the sheath 5 is pushed forward by the ultrasound probe 6, the suture locking member 4 can protrude from the front end of orifice 10.

[0011] It is preferred that the suture 2 used in this embodiment be formed from a biologically absorbable resin, but a non-absorbable suture may be also used. Furthermore, the suture 2 may have a monofilament or multifilament structure. In this case it is preferred that the monofilament have a two-layer structure composed by a core consisting of a material with a high tensile strength and a clad consisting of a material with good fusibility. The monofilament is preferably formed by twisting or braiding the threads. With such a structure of the suture, when the suture 2 is fastened inside the suture locking member 4 and they are connected to each other (described below), the suture locking member 4 is engaged with the twisting or braiding grooves of the suture 2, thereby increasing the joining strength and making it difficult for the suture 2 to slip out of the suture locking member 4. Furthermore, in this case, the multifilament can be composed of different materials.

[0012] The suturing needle installed at the front end of suture 2 can be linear, curved, or linear with a curved tip; it is appropriately selected and used according to the suturing region.

[0013] Suturing of body tissue with the suturing instrument 1 having the above-described structure will be described below with reference to Fig 2. First, the suturing body 20 is set into the sheath 5. This operation is carried out by slightly pulling the ultrasound probe 6 located inside the sheath 5 to an operating portion side, thereby forming a space capable of receiving the suture locking member 4 inside the front end portion of the sheath 5, and setting the suture locking member 4 inside the space.

[0014] Then, the sheath 5 having the suture 20 set therein is inserted into a body cavity via a thoracal (not shown in the figure). The body tissue 30, which is to be sutured, is pierced with the suturing needle 3, while the suturing needle 3 is being held with a needle holder (not shown in the figure) inserted into the body cavity via a separate route, and the suture 2 that went through the body tissue 30 is pulled into a U-shaped groove 4a of the suture locking member 4 (the state shown in Fig 2(a)).

[0015] In this state, as shown in Fig 2(b), the suture 2 is tensioned with a forceps 32 and the separate portions of the tissue are joined by the tension force. At the same time, the ultrasound probe 6 is moved forward inside the sheath 5 and pressed against the suture locking member 4. In this state, the front end of sheath 5 is pressed against the suturing region of tissue 30. In such a state, ultrasonic waves from the ultrasound probe 6 are transmitted into the suture locking member 4. As a result, the inner portion of the suture locking member 4 generates heat and becomes softened under the effect of ultrasound waves from the ultrasound probe 6. It is also easily deformed under the pressure applied by the ultrasound probe 6 and fastens the thread 2. At this time, when the suture locking member 4 is pushed out to the tissue 30 side by the ultrasound probe 6, while the suture locking member 4 is being deformed and the suture 2 is being pulled, and the sheath 5 is pulled back to the operating portion side (state shown in Fig 2(c)), the suture locking member 4 slips out of the front end of orifice 10 (sheath 5) and is brought in contact with the suturing portion of tissue 30. At the same time, the suturing strength of tissue 30 is increased.

[0016] Then, the suture 2 and suture locking member 4 are left in this state inside the body. At this time, the excess suture 2 is cut with a scissors-like forceps and recovered together with the suturing needle 3. This operation completes the suturing of tissue.

[0017] As described above, with the medical suturing instrument 1 of this embodiment, the suture 2 can be easily pulled into the suture locking member 4 by using the U-shaped groove 4a formed in the suture locking member 4. Moreover, in a state in which the suture 2 is located inside the U-shaped groove 4a, the suture locking member 4 is deformed by ultrasound waves in order to fasten the suture 2, thereby providing for reliable, easy, and speedy locking of suture.

[0018] Furthermore, since the suture 2 is fastened and connected as a result of deformation of the suture locking member 4 by ultrasonic waves, the suturing strength is higher than that obtained when the sutures 2 are joined to each other and locked, or when the suture 2 and suture locking member 4 are joined by heat. Therefore, subsequent application of an external force cannot loosen the suture or disrupt the connection of the suture locking member 4 to suture 2.

[0019] Moreover, since the deformation of the suture locking member 4 with the ultrasound probe 6 is carried out in a state in which the suture locking member 4 and ultrasound probe 6 are held inside the sheath 5, the suturing operation can be conducted easily and reliably.

[0020] Furthermore, in the medical suturing instrument 1 of this embodiment, the joining strength with which the suture 2 joins the tissue can be maintained in a state in which the suture locking member 4 is pressed against the tissue 30, in other words, suture locking is conducted in a state in which the suture locking member 4 is pressed against the tissue 30. As a result, the suture locking strength is high. Therefore, a reliable suturing operation providing for a high suturing strength can be conducted.

[0021] Fig 3 shows an example of deformation of the suture locking member 4. Thus, the suture locking member 4a shown in Fig 3(a) has a V-like shape, the suture locking member 4b shown in Fig 3(b) has an S-like shape, the suture locking member 4c shown in Fig 3(c) has a W-like shape, the suture locking member 4d shown in Fig 3(d) has a Z-like shape, the suture locking member 4e shown in Fig 3(e) has an X-like shape, and the suture locking member 4f shown in Fig 3(f) has an H-like shape. In all the cases, there is at least one groove 35 into which the suture 2 can be easily pulled.

[0022] With such a structure, the suture 2 used to suture the tissue can be pulled into any of grooves 35 according to the type of tissue to be sutured or a procedure used. In other words, it is possible to select a groove 35 into which the suture 2 is to be pulled. Thus, if the suture 2 can be pulled into the convenient groove 35, the suturing operation can proceed smoothly.

[0023] The suture locking member 4g shown in Fig 3(g) has a horn-like shape. With such a structure, the suture 2 that was used to suture the tissue is inserted together with the suturing needle 3 into the suture locking member 4g through a wide opening 38 and is pulled out through a narrow opening 39.

[0024] Since the suture 2 can be completely inserted into such horn-like suture locking member 4g, when the suture locking member 4g is deformed and the suture 2 is fastened, the suture 2 cannot be removed from the suture locking member 4g. Therefore, fastening of the suture 2 can be conducted easily. Furthermore, since the suture locking member 4g has a wide opening 38, the suture can be easily passed through it.

[0025] A suture locking member 40 shown in Fig 4(a) has a plurality of openings 40a, 40b, 40c having different diameters, which are capable of passing the suture 2, and a plurality of grooves 35a, 35b, 35c of different size, which are capable of catching the suture 2 employed for suturing. In other words, the structure of the suture locking member 40 makes it possible to select the openings 40a, 40b, 40c which are to be used for passing and grooves 35a, 35b, 35c which are to be used for catching the suture 2 according to the size of suture 2.

[0026] With such a structure, a knot 41 is formed and the suture 2 is fixed to the suture locking member 40 in a state in which the suture 2 was inserted into one of the openings 40a, 40b, 40c in the suture locking member 40. In such a fixed state, the suture 2 that was used for stitching the tissue is fit into grooves 35a, 35b, 35c to pre-fasten the suture 2. Then, the deformation of the suture locking member 40 is caused by ultrasonic waves and the suture 2 is connected to the suture locking member 40.

[0027] Thus, with such a structure, the suture 2 is pre-fastened when it is fit into grooves 35a, 35b, 35c. Therefore, even if the forceps is separated from the suture 2 after the suture 2 was pulled into the grooves 35a, 35b, 35c with the forceps, when the suture locking member 40 is deformed to fasten the suture 2, the suture is not released from the grooves 35a, 35b, 35c, and the sutured state realized with the suture 2 is not loosened.

[0028] The suture locking member 45 shown in Fig 4(b) consists of two rods 45a, 45b, and these two rods 45a, 45b are joined with a hinge 46 so that they are free to rotate with respect to each other. With such a structure, after the tissue was stitched with the suture 2, the rods 45a, 45b are closed in a state in which the suture 2 used for stitching was placed between the two rods 45a, 45b. In this state, the suture 2 is fastened and fixed by causing the deformation of the suture locking member 45 with ultrasonic waves.

[0029] The suture locking member 50 shown in Fig 4(c) consists of a first member 51 having the suture 2 connected and fixed thereto, and a second member 52 having a fitting opening 54 in which the protrusion 53 formed in the first member 51 can fit. With such a structure, after the tissue has been stitched with the suture 2, the suture 2 can be fastened and fixed if the two members 51, 52 are integrated by fitting the protrusion 53 into the fitting opening 54 in a state in which the suture 2 used for stitching has been placed between the members 51, 52. It goes without saying, that in this state the suturing strength can be increased by causing the deformation of the suture locking member 50 by ultrasonic waves.

[0030] The suture locking member 55 shown in Fig 4(d) comprises a rod-like member 55a. With such a structure, after the tissue was stitched with the suture 2, the suture 2 and the rod-like member 55a are melt fused together in a state in which the suture 2 used for stitching was wound on the rod-like member 55a.

[0031] The suture locking member 60 shown in Fig 5(b) was formed to have a tubular shape; it is provided with a small-diameter orifice 61 adapted to pass the suture 2. Fig 5(a) shows the suturing body 20 having the suture locking member 60. With such a structure, a knot 63 is formed and the suture 2 is fixed to the suture locking member 60 in a state in which the suture 2 was inserted into the small-diameter orifice 61 in the suture locking member 60.

[0032] Fig 6 shows how the body tissue is sutured by using the suturing body 20 having the suture locking member 60 and the suturing instrument shown in Fig 1. Thus, initially, the suture locking member 60 is set inside the front end portion of the sheath 5 via the orifice 10. Then, the sheath 5 having the suture locking member 60 set therein is inserted into a body cavity via a thoracal (not shown in the figure). The body tissue 30 which is to be sutured is pierced with the suturing needle 3, while the suturing needle 3 is being held with a needle-holding instrument (not shown in the figure). The suture 2 that was pulled out from the body tissue 30 was pulled into the inner orifice of the suture locking member 60 (state shown in Fig 6(a)).

[0033] In this state, the suture 2 is now pulled with a forceps 32 and the portions of tissue are connected by the created tension force. At the same time, the ultrasonic probe 6 is moved forward inside the sheath 5 and pressed against the suture locking member 60. In this state, the front end of the sheath 5 is pressed against the suturing portion of the tissue 30. In such a state, the ultrasonic waves from the ultrasonic probe 6 are transmitted to the suture locking member 60. As a result, heat is generated inside the suture locking member 60 under the effect of ultrasonic waves from the ultrasonic probe 6 and the locking member is softened. At the same time it is readily deformed under the pressure applied by the ultrasonic probe 6 and fastens the suture 2. If in this state the suture locking member 60 is pushed out toward the body tissue 30 by the ultrasonic probe 6, and the sheath 5 is pulled back toward the operating portion, while the suture locking member 60 is being deformed and the suture 2 is being tensioned, the suture locking member 60 will be pulled out from the front end of orifice 10 (sheath 5) and pressed against the suturing portion of tissue 30. In addition, the strength of tissue suturing will be increased (see Fig 6(b)).

[0034] Then, the suture 2 and suture locking member 60 are held in such a state inside the body. At this time, the excess suture 2 is cut out with a scissors-like forceps 69 (see Fig 6(b)) and recovered together with the suturing needle 3. This stage completes the tissue suturing operation.

[0035] Then, when another tissue portion is to be sutured, the suture 2 cut with the scissors-like forceps 69 is passed through the small-diameter orifice 61 of the suture locking member 60 which is prepared separately (see Fig 6(c)), and again a knot 63 can be formed (see Fig 6(d)).

[0036] Thus, the suture locking member 60 having the above-described structure can be employed many times, thereby making it possible to use repeatedly one suture 2 for suturing in several places and increasing the cost efficiency. Furthermore, since the suture locking member 60 was formed to have a tubular shape and the suture 2 can be completely inserted therein, the suture 2 is not released from the suture locking member 60 when the suture locking member 60 was subjected to deformation to fasten the suture 2.

[0037] Fig 7 shows a modification of the suture locking member 60. The suture locking member 60a shown in Fig 7(a) has a plurality of orifices 61a, 61b, 61c with different diameters into which the suture 2 can be inserted. With such a structure, after the suture 2 having a thickness appropriate for suturing was selected, the suture 2 is passed through the orifice 61a, 61b, 61c having a diameter corresponding to the thickness of the selected suture 2. Then, a knot 63 is formed at the end of suture 2. Such a structure is convenient because sutures 2 of various thickness can be used.

[0038] The suture locking member 60b shown in Fig 7(b) has a groove 70 which is wide at its opening and narrow at its tip. With such a structure, after the suture 2 having a thickness appropriate for suturing was selected, the suture 2 is fit into the groove 70 to a depth corresponding to the thickness of the selected suture 2. The suturing operation is facilitated because it is not necessary to form the knot 63 at the end of suture 2.

[0039] The suture locking member 60c shown in Fig 7(c) has a plurality of grooves 73a, 73b, 73c of different thickness. Such a structure is convenient because the groove 73a, 73b, 73c into which the suture 3 is to be fit can be selected according to the suture thickness.

[0040] The suture locking member 60d shown in Fig 7(d) has a hook-like protrusion 75. With such a structure, after the suture 2 appropriate for suturing was selected, the suture 2 is fastened to the protrusion 75.

[0041] The suture locking member 60e shown in Fig 7(e) has a protrusion 76 with an opening 77. With such a structure, after the suture 2 appropriate for suturing was selected, the suture 2 is fastened to the opening 77.

[0042] Furthermore, in the above-described embodiment, the suture was joined to the suture locking member by causing the deformation of the suture locking member. However, it goes without saying that these elements can be joined by attaching in contact, melting to cause adhesion, and attaching by pressure. Furthermore, in the above-described embodiment, the suture locking member was deformed by ultrasonic waves. However, it goes without saying that the deformation of the suture locking member can be also caused by laser radiation, heating, electromagnetic waves, electricity, vibrations, chemical reactions and the like.

[0043] Various structures described in the following clauses can be obtained by using the modifications explained above.

1. A medical suturing instrument comprising a suture locking member having a suture connected and secured thereto and having at least one receiving portion capable of receiving a portion of the suture, a sheath capable of being inserted into a surgical region and capable of setting the suture locking member so that it can be freely detached therefrom, and suture locking means which is arranged inside the sheath and which fastens and fixes the suture contained inside the receiving portion of the suture locking member by causing the deformation of the suture locking member set into the sheath.

[0044] 2. The medical suturing instrument as described in Clause 1, wherein the suture locking means causes the deformation of the suture locking member by ultrasonic vibration energy. With

the structure of Clause 2, the suture can be rapidly fixed to the suture locking member. In this case, the ultrasonic vibration energy causes heat generation inside the suture locking member and fusion of the contact surfaces of the suture locking member.

[0045] 3. The medical suturing instrument as described in Clause 1, wherein the suture is connected and fixed to the suture locking member so that it can be freely detached therefrom. With the structure of Clause 3, the suture can be repeatedly used during surgery.
4. The medical suturing instrument as described in Clause 1, wherein the receiving portion of the suture locking member can fasten the suture.

[0046]

[Effect of the Invention] As described above, with the medical suturing instrument in accordance with the present invention, a sufficient suturing strength can be obtained by simple suturing operations. Thus, in the medical suturing instrument in accordance with the present invention, the suture can be easily pulled into the suture locking member by means of a receiving portion formed in the suture locking member. Moreover, the suture can be fastened by causing the deformation of the suture locking member in a state in which the suture was pulled into the receiving portion. Therefore, the suture can be locked reliably, easily, and rapidly.

[0047] Furthermore, since the suture is fastened and joined by causing the deformation of the suture locking member, the suturing strength is higher than that obtained when the suture is press attached to the suture locking member under heating or when the suture is locked by joining to itself. Therefore, the sutured state is not loosened under the subsequently applied external force and the connection state of the suture locking member and suture is not degraded.

[0048] Moreover, since the deformation of the suture locking member by the suture locking means can be conducted in a state in which the suture locking member and suture locking means are held inside a sheath, the suturing operation can be carried out easily and reliably.

[Brief Description of the Drawings]

Fig 1(a) is a structural diagram of a suturing body constituting a medical suturing instrument relating to an embodiment of the present invention. Fig 1(b) is a plan view showing the main part of the medical suturing instrument, Fig 1(c) is a side sectional view showing the main part of the medical suturing instrument.

Fig 2 shows a mode of suturing operation using the medical suturing instrument shown in Fig 1.

Fig 3 shows the modification of the suture locking member constituting the suturing body.

Fig 4 shows the modification of the suture locking member constituting the suturing body.

Fig 5 shows the modification of the suture locking member constituting the suturing body.

Fig 6 shows a mode of suturing operation using the suturing body shown in Fig 5.

Fig 7 shows the modification of the suture locking member shown in Fig 5.

[Legends]
1 – medical suturing instrument, 2 – suture, 3 – suturing needle, 4 – suture locking member, 4a – receiving groove (receiving portion), 5 – sheath, 6 – ultrasonic probe (suture locking means)

Fig 1(b)
Medical suturing instrument